LaTeX Tutorial

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Abstract

This tutorial will go through the steps required to start writing scientific reports with LaTeX and get you on your way to a life free of typesetting hassles. LaTeX is a scripting language specifically designed for mathematicians and scientists to write scientific articles and reports. This tutorial will illustrate what is needed to start writing with LaTeX, gives an overview of how LaTeX works and some useful commands to get you stated.

Contents

1 Introduction

TEX was developed by Donald Knuth in 1978 [1] to help scientists publish papers in a standard format without having to worry about formatting, typesetting, alignments, references, etc. LATEX is a scripting language, this means that you will write in a script and then execute it to generate a .pdf file. This has several advantages including; low computation requirements, platform independent, horizontal and vertical alignment, smart automatic float (image, table, equation, etc.) placements, automatic numbering, easy cross-referencing and more.

Being a scripting language one will have to inform LATEX about any formatting by writing commands such as `\section{name}`. This might seem to be more complicated but it is easier than using a user interface. By writing such commands all typesetting formats will be implied according to initial settings. More of these commands will be explained in section 4.

2 Installing a LATEX editor

Before writing in LATEX one has to install the required libraries for the computer to understand the scripts. If you are running on a Mac or windows system this is accomplished by installing MiKTEX[1], if you're running a Linux system this is probably already installed. After installing MiKTEX you will now need to install a suitable LATEX editor (a shell program) to write the LATEX scripts. The shell program I will be using for this tutorial is **TeXMaker**, this is an open-source cross-platform editor. Other TEX editors like TeXmacs and TeXshop, for macintosh, exist. TeXMaker can be freely downloaded[2] and installed for any operating system.

3 Writing your first LATEX document

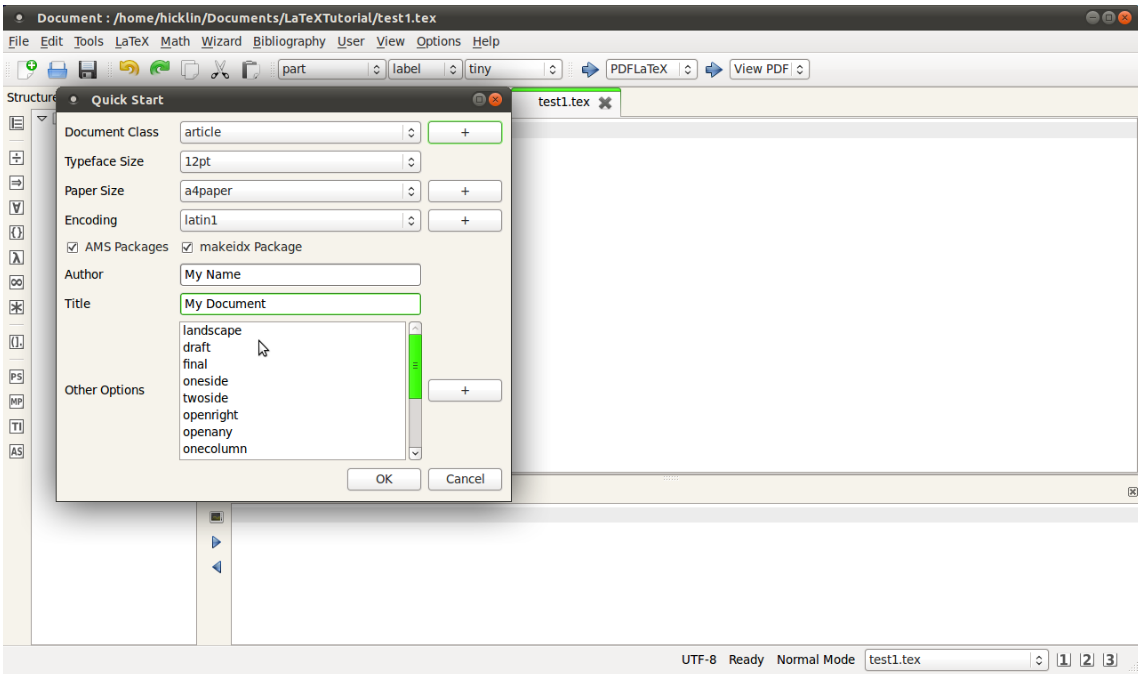
- A LATEX document is written in a `.tex` file, which is similar to a `.txt` file.
- In TeXMaker a new `.tex` file can be created using *ctrl+n* or from tab File > New.
- At the beginning of a LATEX document one has to set certain document parameters like font size, document class, paper size, page layout, etc. This is called the preamble.
- In TeXMaker this list of initial commands can be easily created using the *Wizard* tab. Figure 1 shows the wizard window where you can specify the

[1] `http://miktex.org/2.8/setup`

[2] `http://www.xm1math.net/texmaker/download.html`

document class, font size, author, title, etc. This will generate the preamble and the commands `\begin{document}` & `\end{document}`.

- Anything between a `\begin{}` & `\end{}` is called an environment and within the document environment you can start writing your document.
- Writing a new document will normally start by the title page which is easily created by writing `\maketitle` in the document environment. To view the effect of this command we have to execute the script and generate a pdf file. To do this, click on the drop down menu after the first blue arrow (Figure 2(a)) and choose *PDFLaTeX*, clicking on the blue arrow will now execute the script and generate the pdf. To view the pdf document click on the drop down menu after the second blue arrow (Figure 2(b)) and choose *View PDF*, clicking on the second blue arrow will open the generated pdf with the default pdf viewer.
- If you continue to write in your `.tex` file you can view the changes in the pdf by clicking on the first arrow (or pressing F6) and viewing the pdf again. Running PDFLaTeX will overwrite the last pdf.



Document : /home/hicklin/Documents/LaTeXTutorial/test1.tex

Quick Start

Document Class: article

Typeface Size: 12pt

Paper Size: a4paper

Encoding: latin1

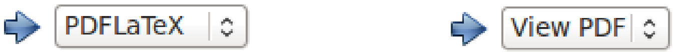
☑ AMS Packages ☑ makeidx Package

Author: My Name

Title: My Document

Other Options: landscape, draft, final, oneside, twoside, openright, openany, onecolumn

Figure 1: This figure shows the window generated when clicking the wizard tab



(a) First blue arrow (b) Second arrow

Figure 2: Settings for the blue arrows

- While writing your document you will need to create sections and subsections which have a different type setting then the rest of the text. This is done by simply writing `\section{SectionName}`. This command will automatically number and write the section title in the appropriate format according to the document class and font size specified in the preamble.

- Similarly one can also create subsections (`\subsection{}`) and subsubsections (`\subsubsection{}`).
- When writing a document, paragraphs may be either separated by a line, and no indentation, or just by indentation. To specify the preferred method, one must add the commands `\parindent 0pt` & `\parskip 2ex` in the preamble, therefore before the `\begin{document}`. These particular settings will create a line separated document.

The commands discussed until now will help you create a neatly structured document. The next section will show some other useful command for inserting equations, figures, tables, references and cross-references.

4 Useful Commands

LaTeX has been around for quite some time and a lot of people have realised its potential to make report writing much easier. Since the language is open-source, a lot of people have written different packages to solve different problems. Most of these packages where installed during the MikTeX installation. To avoid conflicts one has to specify which packages are going to be used in the document. This is done by adding the command `\usepackage{Name}` with the package name in the preamble.

4.1 Equations

To write equations and use Greek letters no packages are required since this is the main purpose of LaTeX. However, Greek letters must be written inside an equation environment. Below are examples of the different equation environments in LaTeX.

1. New line + numbered [2]

```
\begin{equation}
\int_0^{\infty} e^{-\rho} \rho^{2l}\left[ L_{n+l}^{2l+1} \left(\rho
\right) \right]^2 \rho^2 d\rho = \frac{2n \left[\left(n+l\right)!
\right]^3}{(n-l-1)!}
\end{equation}
```

$$\int_0^{\infty} e^{-\rho} \rho^{2l}\left[L_{n+l}^{2l+1} \left(\rho\right) \right]^2 \rho^2 d\rho = \frac{2n \left[\left(n+l\right)! \right]^3}{(n-l-1)!} \tag{1}$$

2. New line [3]

   ```
   \[
   \bar{N}_j^g = \frac{\sum\limits_{k} N_{jk} W_k}{\sum\limits_{K} W_k}
   \]
   ```

   $$\bar{N}_j^g = \frac{\sum\limits_{k} N_{jk} W_k}{\sum\limits_{K} W_k}$$

3. In-line

   ```
   Velocity ($\vec{v} = \dot{x} = \frac{\partial x}{\partial t}$) is ...
   ```

   Velocity ($\vec{v} = \dot{x} = \frac{\partial x}{\partial t}$) is ...

The first environment writes the equation on a new line and numerates it, the second environment writes the equation on a new line and the third environment writes the equation in-line. So to write Greek letters in-line one has to write `$\psi$` which gives ψ.

4.2 Figures

To include figures in a document the package *graphicx* is required, so the command `\usepackage{graphicx}` must be written in the preamble. To add a figure one can write the following commands.

```
\begin{figure}[h!] % between [] you put options e.g. ht = here top
\includegraphics[width=0.5\textwidth]{directory/to/file.png}
\caption{This figure shows a plot of $\psi^2$ vs. $x$}
\label{Cross-reference_key}
\end{figure}
```

The figure environment informs LaTeX that the float is a figure and is therefore numbered accordingly. One can also use a table environment (`\begin{table}`) for inserting tables as pictures. `\includegraphics[]{}` is the command that resizes, transforms and positions the image. There are several ways of resizing an image (width, height or scale), the particular command `width=0.5\textwidth` resizes the image to 50 % of the text width. The command `\label{Cross-reference_key}` labels the figure using the key written between `{}`. This can be used to refer to the figure number by simply writing `\ref{Cross-reference_key}` anywhere in the document. It makes it easier to refer to the figure and the number will change automatically as the figure number changes.

`[h!]` is an option of the figure environment. This tells LaTeX to put this image in the next available space. Therefore if the image does not fit where it was written in the `.tex`, LaTeX will move the float to the next page and shift some text on top of it to minimise empty spaces.

4.3 Referencing

Referencing is usually a very strenuous and time consuming procedure which is made much easier in LaTeX. Citations are created from a `.bib` file containing information regarding the citation material e.x. title, journal, volume, issue, pages, etc. This information must be written inside the `.bib` file in a particular format so that LaTeX can draw information as required from the particular citation style. Below is an example of how to add information about a paper in a journal. In TeXMaker these commands can be generated from the *Bibliography* tab.

```
@Article{CiteKey,
author = {},
title = {},
journal = {},
year = {},
volume = {},
number = {},
pages = {},
month = {}
}
```

After entering the required information, the material can be cited by using the custom citation key (CiteKey) in the command `\cite{CiteKey}`. To generate the references one must first add the following commands where the reference section is going to be placed.

```
\bibliographystyle{}% Select the citation style e.g. ieeetr
\bibliography{}% write the directory to the .bib file
```

Now to generate the citation first click on the drop down menu in front of the first blue arrow and choose *Bibtex* (or just press F11), run it twice then run *PDFLaTeX* twice. This will print a *references* section with the citations referred to in the document, numbered according to occurrence.

This procedure can be made even simpler by either using the journal website obtain the `.bib` code or by using paper managing programs, such as **Mendely**[3]. These programs will automatically read off information from proper pdf formatted papers, reducing the need for manual input of data, and can output the information in a .bib file directly.

[3] http://www.mendeley.com/

5 Further Reading

In this tutorial, and the accompanying appendix, you have been given the required information to start writing you reports with LaTeX. This document is by no means a comprehensive tutorial and a lot of other useful packages exist. Some other recommended packages are siunix (for writing appropriate SI units), mhchem (for easy chemistry equation writing) and hyperref (for making a clickable document). Most of what you will need regarding the use of LaTeX can be found on the LaTeX wiki book[4].

[4] `http://en.wikibooks.org/wiki/LaTeX`

References

[1] http://gcc.gnu.org/ml/java/1999-q2/msg00419.html, 12 2011.

[2] N. Zettili, *Quantum Mechanics concepts and applications.* Wiley, 2 ed., 2009.

[3] G. L. S. Francis W. Sears, *Thermodynamics, Kinetic Theory, and Statistical Thermodynamics.* Addison Wesley Longman, 3 ed., 1986.

A Page layout

Changing the default page layout can be easily done through the *geometry* package. Below is an example of how to use it. The options give the widths of the top, bottom, left and right margins.

```
\usepackage[top=2.5cm, bottom=2.5cm, left=3cm, right=3cm]{geometry}
```

B Sub-equations

Sub-equations have the same number but a different letter is added e.x.

$$e^{i\pi} + 1 = 0 \tag{2a}$$

$$\nabla \times \mathbf{H} = \frac{\varepsilon}{c} \frac{\partial \mathbf{E}}{\partial t} \tag{2b}$$

To do this the code below was used

```
\begin{subequations}
  \begin{equation}
    e^{i\pi} + 1 = 0
    \label{1a}
  \end{equation}

  \begin{equation}
    \nabla \times \mathbf{H} = \frac{\varepsilon}{c} \frac{\partial \mathbf{E}}{\partial{t}}
    \label{1b}
  \end{equation}
  \label{1}
\end{subequations}
```

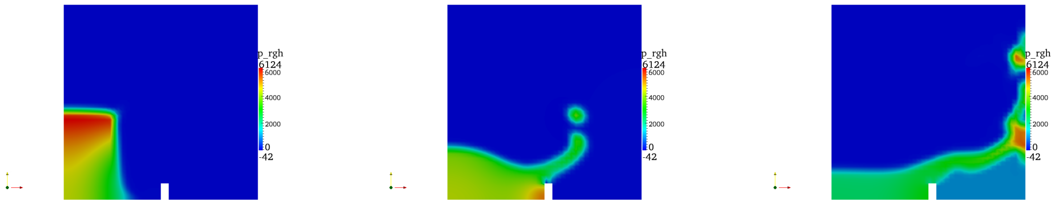
C Sub-figures

Sub-figures have the same number but a different letters, as shown in figure 3

This was done by first adding the *subfigure* package to the preamble and then writing the following code.

```
\begin{figure}[h!]
\centering% centres the three figure
  \mbox{% makes a mini box to keep the three figures side by side
    \subfigure[$t = 1$ s]{% between [] is the caption
```

```
      \includegraphics[width=0.32\textwidth]{Pics/db0001.png}
      }% between the [] are the size options
    \subfigure[$t = 3$ s]{
      \includegraphics[width=0.32\textwidth]{Pics/db0003.png}
      }% between {} the picture location
    \subfigure[$t = 5$ s]{
      \includegraphics[width=0.32\textwidth]{Pics/db0005.png}
      }}
\caption{Fluid pressure during breaking of a dam on Jupiter.}
\label{subfig}
\end{figure}
```



(a) $t = 1$ s (b) $t = 3$ s (c) $t = 5$ s

Figure 3: Fluid pressure during breaking of a dam on Jupiter.